2-6. Detector Kit, Chemical Agent, M256A1.

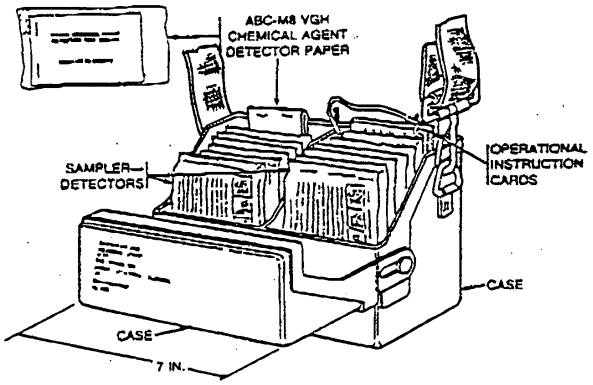
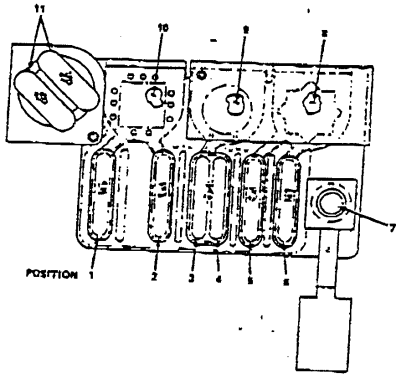


Figure 6. Detector Kit, Chemical Agent: M256A1



Location of Components of the M256A1 Chemical Agent Detector Kit

Each M256A1 Chemical Agent Detector Kit contains 12 samplers and a booklet of M8 paper.

Form	Content/Unit	Total Quantity/Kit
Ampoule No. 5 (clear liquid, Position #1)	Potassium carbonate (0.24 gm/ampoule)	2.88 gm
	Water (0.4 ml/ampoule)	4.88 ml
	1 ampoule/sample	

Form	Content/Unit	Total Quantity/Kit
Ampoule No. 3 (clear liquid, Position #2)	4-(4'nitrobenzyl) pyridine (2.25 mg/ampoule)	0.027 gm
	Mercuric cyanide (2.64 mg/ampoule)	0.032 gm
	Methanol (0.2 ml/ampoule) 1 ampoule/sampler	2.4 ml
Ampoule No. 3 (clear liquid with green pellet, Position #3)	4 parts of 4-benzyl pyridine in 396 parts of 2-methoxy ethanol (0.4 ml/ampoule) 1 ampoule/sampler	4.8 ml
Ampoule No. 3 (clear liquid, Position #4)	Sodium hypochlorite (0.79%) Water (0.15 ml/ampoule) 1 ampoule/sampler	1.8 ml
Ampoule No. 3 (clear liquid with orange pellet, Position #5)	Buffer pH8: Tris-(hydroxymethyl)-amino-methane (0.00303 gm/ampoule)	0.03636 gm
	Hydrochloric acid, 0.1N (0.143 ml/ampoule)	1.72 ml
	Aerosol OT (0.13 mg/ampoule) 1 ampoule/sampler	1.56 mg
Ampoule No. 5 (Position #6)	Indoxyl acetate (2.5 mg/ampoule)	0.03 gm
	Tetrahydrofuran (0.05 ml/ampoule)	0.6 ml
	Ligroine (0.475 ml/ampoule) 1 ampoule/sampler	5.7 ml
Pellet (tab 1, Position #7)	4,4-Bis(dimethylamino)-thiobenzophenone (0.022 gm/tablet)	0.264 gm
	Zinc oxide (0.088 gm/tablet)	1.056 gm
	Titanium dioxide (0.088 gm/tablet)	1.056 gm
	Amorphous silica (0.088 gm/tablet)	1.056 gm
	Ball clay (0.0202 gm/tablet)	0.2424 gm
	Amioca starch (0.0044 gm/tablet)	0.0528 gm

Form	Content/Unit	Total Quantity/Kit
	Microcrystalline cellulose (Avicel) (0.11629 gm/tablet)	1.34 gm
	Stearic acid (0.0132 gm/tablet) 1 tablet sampler	0.158 gm
Detector spot (star shape, Position #8)	Eel acetyl cholinesterase (5 units/sampler, or 0.016 mg/sampler)	0.192 mg
	Buffer pH8: Piperazine-N,N'-bis-(2-hydroxypropane sulfonic acid) $2H_20$ (POPSO) 9.96 mg/sampler)	0.1195 gm
	Bovine serum albumin (0.25 mg/sampler)	0.003 gm
	1% Triton X-100 (0.00075 ml/sampler)	0.009 ml
Detector spot (circular shape, Position #9)	1% by weight of Barbituric acid impregnated on glass fiber disk 1 spot/sampler	0.48 mg
Detector spot (square, Position #10)	Chromatography grade silica gel paper	
Ampoule No. 4 (double, Position #11)	Cupric chloride (0.8 gm/ampoule)	9.6 gm
	Ethylene glycol (0.4 gm/ampoule)	4.8 gm
	Distilled water (0.8 ml/ampoule) 1 ampoule/sampler	9.6 ml
Heater (under (Ampoule No. 4)	Aluminum powder (0.285 gm/pad)	3.42 gm
	Paper pulp (0.189 gm/pad) 1 pad/sampler	2.27 gm
ABC-M8 detector paper	See section 2.15	1 bklt

road haul and drop. Samplers from the kits were tested for agent sensitivity (paragraph 2.6).

2.12.4 Results

The cover of one carrying case was cracked when dropped from a moving vehicle as required by the test plan. The crack in the plastic cover was near the pivot point on the side of the cover and was approximately 1 1/2 inches long. See Figure B-14, Appendix B for photograph of cracked case cover. The cover was weakened but was usable. There was no visible damage to cases or components. Inspection and agent challenge during subtest 2.6 revealed the samplers were in satisfactory physical condition with a good reliability of response to agent.

2.12.5 Analysis

Since the case and components were in satisfactory condition and the samplers demonstrated a high reliability of response to agent, the criterion was met with respect to transportation in vehicles.

2.13 Interference (XM256)

2.13.1 Objective

To determine whether the response of the kit was altered by the presence of gases, vapors or aerosols of other substances likely to be encountered in the field

2.13.2 Criteria

a. "Will the XM256 kit provide a degraded and/or false response in the presence of vapors from chemical mixtures and compounds found on the battle field?" (Item 5, Part 1, Appendix A)

b. "The kit shall provide the capability to detect and classify chemical agent contamination within its designed capabilities in the presence of vapors, gases, and aerosols expected to be encountered in the field. Furthermore, no known standard chemical agent (lethal or incapacitating) which is outside the designed test capabilities shall interfere with normal operation of the kit." (Item 4, Part 3, Appendix A)

c. "Decontamination characterisitcs and operational capability of this detector kit in battlefield environments are addressed at MN Items 4 and 21, Part 3, Appendix A." (Item 33, Part 3, Appendix A)

2.13.3 Data Acquisition Procedures

General interference was considered to occur when the test substance caused either inhibition or a false response (a false response is a

positive sampler reaction in the absence of chemical agents; inhibition is the failure of the sampler to respond to chemical agents).

a. Source of Agent Simulant. During the inhibition tests, simultaneous contact of the potential inhibitor and the agent simulant was desirable. Agent simulants were provided by the Simulant Chemical Agent Identification and Training Set (SCAITS), and the Lewisite simulant as used in subtest 2.3.

b. Number of Samplers Tested. Kits 160 through 186 were designated for this subtest by the test plan. If extra samplers were required it was planned to use samplers from the kits previously subjected to aerial delivery. Extra samplers were required because of some false-positive responses. Since the aerial delivery tests were not completed, samplers from seven extra kits were used. These seven kits were not designated for test by the test plan.

For each potential inhibitor, five tests were performed with each of the four simulants. To reduce the number of samplers needed, samplers were dissected in a manner to allow for separate nerve, blister, blood and Lewisite simulant tests. Thus, one segmented sampler provided components for tests with the four simulants. For inhibition tests, samplers were exposed for the time required for sampling or as limited by the amount of material produced.

For false positive tests, 18 complete samplers (not dissected) were used with each potential interfering material. Half of the 18 samplers were exposed as long as possible (a maximum of 10 minutes) to the material listed in Table 38. The other half of the 18 samplers were exposed as long as possible (a maximum of 25 minutes) to the material listed in Table 38.

c. Method of Sampler Exposure. For inhibition tests, the five samplers were exposed simultaneously to the simulant and potential interfering material, unless operator safety prohibited personnel being in the vicinity of the substance being produced. For example, personnel could not operate the samplers in a dust chamber or to be near the point of detonation of TNT. Where safety prohibited simultaneous exposure of sampler to simulant and potential interfering material, the samplers were clipped to metal stakes about 18 inches above the ground. The potential interfering material was then produced in a manner that insured contact with the samplers. Immediately after exposure to the potential interfering materials, the samplers were tested with the appropriate simulants. Simultaneous exposures of the simulant and potential interfering material was achieved with vapors of burning brush, exhausts, decontaminants, fuels, fog oil, HC smoke, decomposing waste, colored smoke grenades, defoliants, and salt spray. For vapors

Table 38. Substances for Interference Test

Test Substance	Test Procedures
Burning brush and rubbish	Tested in the path of the smoke
Exhaust fumes	Tested 1 meter downwind from the exhaust of two vehicles (one gasoline and one diesel) parked with engines running
Decontaminants	Tested 5 meters downwind from separate pans containing supertropical bleach slurry, high-test bleach slurry, DS2 solution, and paraformaldehyde (paraformaldehyde was cooked-off with a hotplate)
CS	Test 75 meters downwind from CS samples. One grenade was functioned during the first 10 minutes, and the second grenade was functioned during the next 15 minutes. Samplers used for inhibition tests were exposed to CS from only one grenade.
Fumes of detonated TNT	Tested in the path of fumes produced by the detonated TNT. One pound of TNT was detonated during the first 10 minutes, and a second pound of TNT was detonated during the next 15 minutes.
Fumes of burning explosive	Tested in the path of fumes of the burning explosives. During the first 10 minutes, 908 grams of rifle powder, 908 grams of artillery propellant and 2,876 grams of solid rocket propellant were burned. During the next 15 minutes, 908 grams of rifle powder and 908 grams of artillery propellant were burned.
Fuel vapors	Tested downwind from open containers of diesel fuel, gasoline, kerosene, motor oil, and antifreeze.
HC smoke	Tested 25 meters downwind from HC smoke grenades. One grenade was functioned during each of the 10- and 15-minute sampling periods.
Fog oil smoke	Tested 25 meters downwind for the smoke thermally generated (approximately 7 liters were used)
WP smoke	Tested in the path of the WP smoke generated by the remote detonation of M34 grenades. One grenade was functioned during each of the 10- and 15-minute sampling periods.
Decomposing waste	Tested in the vicinity of dead animals (dead for 2 weeks or more) and human waste.
Colored smoke	Tested 25 meters downwind from red, yellow, green and violet colored M18 smoke grenades. One grenade of each color was functioned during each of the 10- and 15- minute sampling periods.
Defoliants	A mixture of 2,4 dichlorophoxyacetic acid (37.7%) and 3,5,6 trichloropicnolic acid (10.7%) was sprayed approximately 25 meters upwind of the samplers.
Dust	Tested in a dust chamber of blowing sand. The dust concentration was 1.8 grams per cubic meter.
Salt spray	Tested in a chamber under the conditions specified for the salt-fog test in MIL-STD-810C, Method 509.1 (reference 6).

of CS grenades, explosives, WP grenades, and dust test; the samplers were exposed to the simulants immediately after exposure to the potential interfering material.

All samplers tested for false-positive responses were exposed to potential interfering materials by clipping the samplers to the metal stakes about 18 inches above the ground. The potential interfering material was produced in manner that allowed maximum contact with the sampler.

d. Test Personnel. The operators worked independently and interpreted the results independently. In addition, the sampler response was evaluated and recorded independently by an observer. Tests with each potential inhibiting material were distributed as evenly as practical among the operators.

e. Potential Interfering Materials. Each substance listed in Table 38 was tested. The field tests were not conducted during precipitation, in winds greater than 16 km/hr, or when air temperature was above 105°F or below 50°F. Before use, the samplers were inspected for physical defects which might have prevented a valid test.

2.13.4 Results

2.13.4.1 Physical Condition of Samplers. During the inspection of 374 samplers, 11 samplers were defective because of broken or dry ampoules. The No. 3 blister ampoules were broken in eight samplers, and the No. 3 nerve ampoules were broken in two samplers. In one sampler, the No. 3 ampoule was dry, and the orange bead was missing.

2.13.4.2 Sampler Response

Results of the test for inhibition and false positive responses are contained in Tables 39 and 40, respectively.

As shown in Table 40, only false-positive responses occurred, and inhibition was not observed during the interference tests. Those false-positive responses that occurred are shown in Table 41.

After the initial tests with decomposing waste, the Lewisite test marks were light green after 25 minute exposure. Later, it was determined that STB had been added to the waste material. Separate tests were repeated with human waste and decomposing animals. STB was not present during the repeated tests, All samples produced the proper negative response for the repeated tests. Subsequently, nine samplers were exposed above dry STB powder. Nine false-positive Lewisite responses and seven false-positive blister responses occurred with the dry STB. The exposure time and distances at which the samplers were exposed above the STB varied. Five samplers were exposed 3 or 4 inches above the STB for

Table 39. Results of Inhibition Tests

Test Substance	Proportion of false-negative responses			
	Nerve	Blood	Blister	Lewisite
Smoke of burning brush and rubbish	0/5	0/5	0/5	0/5
Exhaust fumes	0/5	0/5	0/5	0/5
Decontaminants	0/5	0/5	0/5	0/5
CS	0/5	0/5	0/5	0/5
Fumes of detonated TNT	0/5	0/5[a]	0/5	0/5
Fumes of burning explosive	0/5	0/5	0/5	0/5
Fuel vapors	0/5	0/5	0/5	0/5
HC smoke	0/5	0/5	0/5	0/5[b]
Fog oil smoke	0/5	0/5	0/5	0/5
WP smoke	0/5	0/5	0/5	0/5
Decomposing waste	0/5	0/5	0/5	0/5
Colored smoke	0/5	0/5	0/5	0/5
Defoliants	0/5	0/5	0/5	0/5
Dust	0/5	0/5	0/5	0/5
Salt fog	0/5	0/5	0/5	0/5

[a]There was a blue color on the blood test spot on one sampler. This is a false-positive response rather than inhibition. Spot did turn pink upon exposure to blood agent simulant from SCAITS.

[b]Lewisite test mark was light green when exposed only to HC smoke, but spot darkened upon exposure to L simulant. This is a false-negative response rather than inhibition.

Table 40. Results of Tests for False-Positive Response

Test Substance	Proportion of false-positive responses							
	10-minute exposure				25-minute exposure			
	Nerve	Blood	Blister	Lewisite	Nerve	Blood	Blister	Lewisite
Smoke of burning brush and rubbish	0/9	1/9	0/9	0/9	0/9	2/9	9/9	0/9
Exhaust fumes	0/9	0/9	0/9	0/9	0/9	0/9[a]	0/9	0/9
Decontaminants	0/9	0/9	0/9	0/9	0/9	0/9	0/9	1/9
CS	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Fumes of detonated TNT	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Fumes of burning explosives	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Fuel vapors	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
HC smoke	0/9	0/9	7/9[b]	7/9	0/9	0/9	9/9[b]	9/9
Fog oil smoke	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
WP smoke	0/9	0/9	0/0	0/9	0/0	0/9	0/9	0/9
Decomposing waste	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9[c]
Colored smoke	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Defoliants	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Dust	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9
Salt fog	0/9	0/9	0/9	0/9	0/9	0/9	0/9	0/9

[a] During the initial series with nine samplers, some small pink spots were present on the blood test spot. The diesel engine was throwing small droplets of oil, which were coming in contact with the samplers. Since the pink spots appeared to be caused by the small droplets of oil coming in contact with the test spots, the tests were repeated with the samplers protected by a shield produced the proper negative responses.

[b] After 1 minute, the light blue streaks faded to colorlessness.

[c] During the initial test, four of the nine Lewisite test spots were light green after 25 minutes of exposure; STB had been added to the decomposing waste. Separate tests were repeated with human waste and decomposing animals (STB was not present), and all samplers produced the proper responses.

Table 41. False-Positive Responses During Interference Test

Interfering Material	Type of false-positive response	Exposure period (min)	Proportion of false-positive response
Smoke of burning brush	Blood	10	1/9
	Blood	25	2/9
	Blister	25	9/9
Decontaminant	Lewisite[a]	25	1/9
HC smoke	Lewisite	10	7/9
	Blister	10	7/9
	Lewisite	25	9/9
	Blister	25	9/9
STB (dry powder)	Lewisite	10	7/7
	Blister	10	5/7
	Lewisite	25	2/2
	Blister	25	2/2

[a]The single false-positive Lewisite response to decontaminants does not indicate a trend.

10 minutes. These five samplers produced false-positive responses for both Lewisite and blister agents. Four samplers were exposed approximately 12 inches above the STB, with two samplers exposed for 10 minutes and two samplers exposed for 25 minutes. The two samplers exposed for 10 minutes produced false-positive responses only for Lewisite. However, the two samplers exposed for 25 minutes produced false-positive responses for Lewisite and blister agents.

2.13.4.3 Difficulty of Rewetting the Nerve Test Spot.

The nerve test spot was difficult to rewet with buffer after the sampling period. Kit instructions direct the operator to rewet the nerve test spot after the sampling period when the sampler is used under high temperature and low humidity. If the nerve test spot dries during the sampling period and is not rewetted with buffer, the nerve test spot produces only a flase-positive response, although nerve agent vapor

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The method for detecting hydrogen cyanide (AC) and cyanogen chloride (CK) involves the reaction of the chemical agent with barbituric acid and 4-benzylpyridine. A solution of barbituric acid in methanol is impregnated on a glass fiber filter paper disk. One ampoule contains a solution of sodium hypochorite and the other ampoule contains a solution of 4-benzylpyridine. When functioning the M256A1 kit, the operator breaks both ampoules. After the 10 minute exposure, a pink or blue color develops if AC or CK is present. CK reacts with the barbituric acid and the 4-benzylpyridine to give the color change. If AC is present, this first reacts with the sodium hypochlorite to form CK; then it reacts with barbituric acid and 4-benzylpyridine to form the pink or blue color.

Nerve agents (G-agents and VX) are detected by an enzyme-substrate method. The filter paper is impregnated with a solution of eel acetylcholinesterase. When operating the M256A1 kit, the ampoule containg the pH 8 buffer solution is broken to wet the filter paper disk. After the 10 minute exposure, the glass ampoule containing a solution of indoxyl acetate is broken. If NO nerve agent is present, the substrate (indoxyl acetate) will react with the enzyme (eel acetylcholinesterase) to form a blue-green color. If nerve agent IS present the enzyme will be inhibited; no enzyme-substrate reaction will take place and NO color will form.

Mustard vapor will react with 4-(4-nitrobenzyl)pyridine (DB3) and potassium carbonate to form the purple/blue color. Phosgene oxime (CX) reacts to form a red/purple color. A solution of DB3 and mercuric cyanide in methanol is contained in one ampoule; mercuric cyanide is included as a catalyst. A solution of potassium carbonate in water is in the other ampoule. When operating the M256A1 kit, the silica gel filter disk is first wetted with the DB3 solution. The wetted filter paper is heated for 2 minutes by breaking the first ampoule in the chemical heater. After the 10 minute exposure the filter paper is heated for one minute by breaking the second ampoule in the chemical heater. The potassium carbonate solution is then added. A color change will occur if mustard is present.

Lewisite reacts with Michler's thioketone, (4,4bis(dimethylamino)thiobenzophenone), to form a green color. The lewisite rubbing tablet contains Michler's thioketone and other inert solids to give the tan color. When operating the M256A1 kit, the tablet is rubbed onto the marking pad; a tan mark appears. After the 10 minute exposure, if lewisite is present, the mark will turn green. If the mark remains tan, no lewisite is present.